

## Urban Farming Models, Ecosystems and Climate Change Adaptation in Urban Environments: The Case of SATURN Pan European Programme

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*The “System and sustainable Approach to virTuous interaction of Urban and Rural LaNdscales” (SATURN) project is exploring how resilience at a city scale might be achieved and how the issues of landscape fragmentation, governance and land management can be addressed resulting in a sustainable future. The EIT Climate-KIC SATURN project is based on a collaboration between three cities of very different scales and contexts, those of Gothenburg in western Sweden, Trento in northern Italy, and Birmingham in the United Kingdom. This paper focuses on the ways in which urban farming can become an important tool to mitigate or adapt to climate change in urban environments by exploring how the three major cities of SATURN deal with these concepts. Using the experience gained throughout the SATURN project as well as the strong communication developed within the consortium, the paper introduces the reasons why urban farming is not just an agricultural activity, but it relates to climate awareness, health and an element of community. With the examples of different urban farming models, this research presents the fully entrepreneurial model of Gothenburg, where a business model fosters sustainable and successful small-scale farming through municipal management of small allotments with associated basic infrastructure leased out to entrepreneurs. Public underutilized land is matched with farmers in order for them to scale up their businesses and provide sustainable food, by limiting the shipping distance of the produce. In the Trento case, bottom-up and more institutional processes have been combined to foster short local supply chains through the Nutrire Trento networking process which could benefit from the introduction of a land lease scheme named “banca della terra” (to support agricultural land recovery). The case of Birmingham presents a different model where farming in an urban environment is mostly seen as a support to communities, mental health and awareness, rather than an entrepreneurial activity. The innovation in this paper comes in the form of different European models related to urban agriculture and best practices, demonstrating how abandoned and underutilised public and private land can be regenerated and become an active part of the urban realm. Insights on the ways in which the three different models operate, as well as results on how farming in an urban environment can enhance resilient cities are discussed in this paper.*

**Keywords:** urban farming, climate change, landscape ecosystems, entrepreneurial agriculture, community farming

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## Introduction

This paper explores a series of urban farming models to examine the ways in which such initiatives can provide effective solutions on climate mitigation and adaptation in urban environments. It is based on methodologies developed at the pan-European project EIT Climate-KIC SATURN (SATURN), testing and evaluating landscape challenges and how these can be addressed through alternative governance and stakeholder engagement. The SATURN project aims to create supportive frameworks and design tools to support cities and regions address the landscape fragmentation they experience, while they explore innovative ideas to future proof their cities. The aim of this paper is to present and discuss one of the pillars of the broader SATURN project, the urban farming/food growing component and explore how urban farming can be beneficial to the fight against a changing climate. The examples of three different urban farming models established and tested in Gothenburg (Sweden), Trento (Italy) and Birmingham (UK) demonstrate how food growing initiatives can be beneficial to the local and broader community. The models discussed by this paper explore different methods based on each country's geographical and cultural characteristics, with the purpose to exchange knowledge and result in best practices and lessons learned for farming within cities or peri-urban areas.

Farming and food growing in urban and peri-urban areas have faced several challenges, especially with the expansion of cities, urbanisation and the mass expansion of agriculture to be able to respond to the great demand for food as well as transportation across the globe. However, what this paper suggests is that, if we are to successfully address the climate crisis, urban farming needs to play a role on how cities are growing their food, at least for a part of the necessary consumption. It is known that cities are increasingly interested in new initiatives, in relation to the climate crisis, constantly experimenting with pioneering schemes and ideas (von Wirth et al. 2019) therefore SATURN's models on alternative urban farming schemes are proven rather relevant. Soulard et al. (2018) suggest that urban agriculture has been an integral part of the society for centuries, either in the form of "gardens, huertas, oases" or else, but urban expansion absorbs agricultural and natural terrains. Although it still exists, urban agriculture is now facing a sharp decline as urban developments grow and agricultural modernization continues. According to Soulard et al. (2018), part of the issue is that farming businesses in peri-urban areas that were targeting national markets and exportations, are now within the jurisdiction of urban policies, a fact that plays a major role in the way in which farms can operate. In addition, Januskiewicz and Jarmusz (2017) state that "the food security problem is far more complex than solely undernourishment or even malnutrition. Understanding the interrelation, scientists are developing sensitive agro-ecosystems and architects are envisioning new kinds of spatial structures for them". Based on such evidence, the SATURN project suggests that specific innovative models need to be designed to establish synergies between agriculture, urban farming and the city, aiming to address food growing in urban environments. The focus of this paper is on the creation of such innovative models as well as how these can be applied spatially at a city or regional level.

Using three pioneering urban farming schemes that have identified either entrepreneurial or social and mental health benefits (Gothenburg, Trento, Birmingham), this paper discusses the various techniques developed around urban farming and underutilized land with the aim to build a sustainable future. The paper suggests that all different models are valuable depending on the goals and challenges each area is facing. The frameworks developed by this project are being tested with the aim to result in an adaptable model that can be transformed and used across different cities and countries.

### **Key Concepts on Urban Farming, Ecosystems and Climate Change**

The climate crisis and the change of the environment is now apparent (IPCC 2018), however the impact on ecosystems, vegetation and living organisms is constantly being examined. According to the UN-Habitat, cities are responsible for 50-60% of the global CO<sub>2</sub> emissions and about 75% of the global primary energy with buildings and transport as major contributors (Mousa et al. 2020). Considering that projections indicate that approximately 70% of the global population will live in cities by 2050 (UN DESA 2018), we ought to think how urban centres are impacting on the environment and what the solutions we have in our hands to accommodate a more sustainable living are. The growth of the urban population will further increase the demand for basic goods such as food products. Consequently, the environmental footprint of food consumption in cities is expected to increase significantly (Pradhan et al. 2020) and therefore a more sustainable food growing chain seems apparent. Examples of sustainable food systems have started to emerge. The C40 Food Systems Network, the Urban Food Policy Pact of Milan as well as Madrid's Food Strategy explore agriculture in urban while aiming at healthy and sustainable cities. Even though we do not have fully developed models and many cities are looking at further opportunities there is a momentum being built and therefore the scope of this paper is considered rather relevant.

Ecosystem is a group of living organisms that interact with each other in a specific environment. The term is often used for natural ecosystems, but it is also common to use it for a complex network or interconnected system, such as the entrepreneurial ecosystem of a city or the regional ecosystem of an area. Whatever the definition, climate crises have a major impact on the ecosystems and as Jennings and Harris (2017) state, "climate change alters the vegetation composition and functioning of ecosystems". Vegetation is a major part of any natural, but also urban ecosystem and any alteration to its composition, due to environmental and climate changes, results in possible threats of this ecosystem. Knowledge around the various climate challenges of an area is considered important for setting priorities for its conservation and restoration (Jennings and Harris 2017). Food growing is part of terrestrial ecosystems and therefore this study recognizes that any impact from climate change will create several challenges to its habitat and any activities taking place in the area. Intensive agriculture contributes to a great share of the biodiversity's loss (Bocchi 2020) and the food growing process has to

be considered in its key role of affecting climate change and societal habits. Agricultural activities are responsible for 10.3% of GHG emissions in Europe, while the food sector contributes 18% of households' GHG emissions (European Commission 2020a). The livestock sector is responsible for 18% of the global Greenhouse Gas emissions (GHG) (Steinfeld et al. 2006) and 75% of the lost biodiversity (Bocchi 2020). As Jennings and Harris (2017) mention, the planet is experiencing a significant amount of climatic flux and changes and therefore, it is important to find ways to predict and protect future vegetation in order for our ecosystems to adapt to the environmental challenges.

This study agrees that the impact of climate change on our landscapes, either urban or rural, is very significant and even though it is now recognised from the broad scientific community, there is still a long way to go to create fully sustainable cities. It was more than a decade ago when Opdam et al. (2009) mentioned “we can be sure of profound effects on ecological processes in and functioning of landscapes. The impact of climate change will affect all types of land use, ecosystem services, as well as the behaviour of humans”. All these seem now apparent, but we are still not entirely sure of the various catastrophic events (wildfires, flooding, hurricanes) that will appear in the future, as we were not expecting a global pandemic (COVID-19). Even though we cannot predict the future environmental catastrophes and their exact timing, it is obvious that they have become more intense and common over the recent years, a fact that has made scientists, decision makers and the public to re-think their way of living. As Grimm et al. (2008) mention, urbanisation is considered a key driver of pollution and climate change, resulting in the alteration of both biotic and abiotic ecosystems either these are in urban or rural areas. With such scientific facts in our knowledge, this study agrees that a resilient and sustainable response to land change must be tackled at local, regional and global scales. The variations of ecosystems at a regional scale are based on different combinations of vegetation, climate and geomorphology (Grimm et al. 2008), and therefore SATURN's approach to examine and test different land use initiatives across Europe seems a valid step to address climate challenges across all scales.

The various changes of the current climate are also affecting the landscape patterns and their processes, and therefore one of the core responsibilities of landscape and ecology professions is to understand how such relationships are manifested across spatial and temporal scales (Opdam et al. 2009). Especially in urban environments, climatic conditions are being greatly affected as a result of the dense construction and population, creating a microclimate which often results in “lighter winds, less humidity, more or fewer rainstorms compared to surrounding rural areas” (Grimm et al. 2008). So, what does this mean for urban farming, and how can we be sure such conditions are suitable for food production? Soulard et al. (2018) agree that the urban agricultural and farming environment is a diverse ecosystem with various dynamics and multidisciplinary elements. Despite the fact that agro-ecosystems face major global issues and they are on decline, different forms of peri-urban agriculture still evolve (Soulard et al. 2018). As pointed out by experts and agreed by this paper, urban farming and peri-urban agriculture demonstrate the capacity to resist to environmental challenges, however issues

such as food security, water scarcity and the conservation of ecosystem diversity need to be addressed (Soulard et al. 2018) if cities and regions are to adapt and mitigate to climate change. The SATURN project is based on these positive indicators, aiming to test and evaluate how urban and peri-urban farming can support the creation of sustainable cities and regions. As Soulard et al. (2018) point out “urbanization heightens agricultural diversity. The disruptions and opportunities created by the pressures of urban growth encourage the development of hybrid agro-ecosystems that adapt to the specific urban conditions or conserve more classical forms”. Together with Opdam et al. (2009) point that “landscape change should be acceptable to local stakeholders and politicians”, SATURN’s approach on involving decision makers and local actors in the establishment of an urban farming model is of great significance.

There is evidence that urban agriculture is of great significance for global food security and that can allow cities to expand while producing clean food and preserve ecological balance of their ecosystems (Mousa et al. 2020). As Li et al. (2020) suggest, “the increasing population and continuous urbanization make food security prominent in sustainable development. It is important to develop economic and resource-efficient farming to meet food demand”. Similar to what this paper explores, Li continues stating that in urban and regional land use there are no “one-size fits all” solutions, but to achieve sustainable agricultural production, decision-makers and farmers need to develop site specific strategies (Li et al. 2020). In spatial and landscape strategies, site specific models are of great importance as they allow for the bespoke development of agricultural models based on each area’s policies, topography and cultural characteristics. Using this evidence, this paper examines three different urban farming models, focusing on the steps required to enhance adaptation and mitigation and how these affect governance, farmers, scientists and other relevant organizations. The importance of this study is justified by Mousa et al. (2020) who explain that “integrating urban farms into the city fabric has many economic, social and environmental benefits. It offers clean food, while improving air quality resulting from carbon emissions and air pollution mitigation” (Mousa et al. 2020). In addition to the pioneering farming models presented below, the broader SATURN project is creating a holistic visioning approach (Nikologianni et al. 2020) to support the establishment of new models and sustainable designs within cities and regions. This approach comes in alignment with Januszkiewicz and Jarmusz’s (2017) indication that “to successfully migrate food production from extensive rural areas to dense environments of city centres, a new holistic approach, integrating knowledge and advances of multiple fields of science, has to develop”. For this to happen, a cross-silo and multidisciplinary approach, that will allow designers, urban planners, engineers and decision makers to redefine contemporary design processes, is needed.

## **Methodology**

This paper’s methodology is based on close examination of urban agriculture and farming models across Europe aiming to examine, test and evaluate the

significance of urban agriculture in food production as well as the possibility for it to become an important aid to sustainable urban development.

SATURN is a pan European project exploring how the issues of landscape fragmentation, governance and land management can be addressed in relation to city resilience. The project requires a minimum of three European countries that are co-funded by the European Institute of Innovation and Technology (EIT) (Nikologianni et al. 2020). The three countries involved Italy (IT), the United Kingdom (UK), and Sweden (SW) formed a consortium and were awarded funds in 2018. The successful team that forms the consortium represents southern, western and northern Europe. SATURN is co-funded by EIT and Climate-KIC, as well as the cities and institutions forming the consortium from November 2018 to December 2021 (Consortium 2019). The broader project's aim is to develop frameworks to support resolving the issues of landscape governance and fragmentation in relation to the climate crisis. To undertake this work, SATURN focuses on the relationships among cities, food growing, and the rural landscape through the development of case studies at each hub. Each partner-city absorbs this new knowledge into their local governance structures. The real-life case studies have distinctly different physical, social, economic, and cultural conditions within a varied range of existing spatial aspirations and contexts. A stakeholder mapping and engagement process is developed through workshops, field visits, and extensive communications, including regular meetings across the consortium.

This paper examines three models developed at the core hubs of SATURN, Sweden, Italy and the UK focusing on the generation of new knowledge and innovative techniques to support food production in a sustainable manner within cities. The entrepreneurial model of Gothenburg (Sweden), the networking process and land lease scheme of Trento (Italy) and the community focused model of Birmingham (UK) are being examined.

The methodology includes the continuous research and development of these pioneering models during SATURN's duration, the processes followed, and the new knowledge generated in relation to the city scale and climate adaptation/mitigation techniques. Continuous engagement with the stakeholders responsible for the development of the urban farming models, their training as well as the collection of results and future steps are part of the methodological process together with training and expert support on sustainability and entrepreneurial models. The use of the public underutilized land model developed in Gothenburg as well as the land lease model of Trento both aim to provide support to farmers to scale up their businesses, but also to cities to improve their land use considering natural resources and future resilience. The case of Birmingham presents a different model where farming in an urban environment is mostly seen as a support to communities, mental health and awareness, rather than a sole entrepreneurial activity. The methods used in this paper include observations, evaluation of the three models in relation to their aims, their location as well as the policies in place in each country. Results indicated that urban farming models are of important value, can be much more environmentally friendly and community oriented and they offer an alternative solution to intensive agriculture.

The data collected for this paper is based on the processes followed for the urban farming models, meetings and policy roundtables with decision makers, observations as well as workshops with the management team of each model. Data were collected and analysed through content analysis.

## **Urban Farming Models**

This section will present three different farming and growing models, selected as case studies during the SATURN project in order to explore how growing can be regenerated in urban environments. Each scheme has demonstrated its own best practices and challenges, depending on the area and policy in place. The three models tackle the broader concept of farming in urban centres, how this contributes to social cohesion as well as the practical side of farming in cities and peri urban centres.

### *The Farm to Table Region - The Case of Gothenburg*

The city of Gothenburg with support from nearby regions has created a unique entrepreneurial model of farming. The aim is to increase urban food production and further green entrepreneurship in and around the city centre in order to identify land use models and strategies for reconnecting cities to their surrounding areas. There is a lot of underutilized land and abandoned buildings in the area of Gothenburg, so the objective is to create a region known for its effective and flexible entrepreneurial system, facilitating small scale commercial vegetable production in the peri urban areas. The Gothenburg model consists of four different pilot actions connected to the enhancement of urban agriculture, redevelopment of abandoned sites, and education of young generations. The challenge is to increase job creation and new farming business models, to increase food security, to improve eco-system services accounting and natural solutions for the climate risk management. The indirect impact is better social inclusion by the participation generation, the better understanding of the geographical identity and revaluation of the urban hinterland. The actions aiming to build a legacy of “Farm to Table Region” for Gothenburg consist of four initiatives dealing with urban farming and entrepreneurship. These are the Model farm, test sites (Angered, Skogome), Farming Incubator and mapping of underutilised land (LAB190).

The Model Farm is developed in cooperation with the City of Gothenburg and the Region Västra Götaland; is a highly productive small-scale farm unit, providing food for schools and elderly care and education at Angereds Gård in peri-urban Gothenburg. The main objective of this activity is to create and demonstrate a successful business model behind a sustainable and small-scale farming enterprise run within a municipality. It serves as a driver for the integration of regenerative farming practices in the continuous evolution of urban and rural multifunctional landscapes. Among the activities of the Model Farm are the creation of a model farm handbook supporting existing and new farmers, webinars and training, study visits to act as educational and awareness for decision makers as well as data

collection on farming practices such as quantity and quality of crops, costs and income calculations for a small scale farm unit. The scheme has been very successful within the community allowing for networking opportunities for young farmers but also acting as an advocate of what can be achieved in a city environment with limited space and resources. The Model Farm has 40 vegetable beds in total, adding up to a total growing area of 600 square meters. It aims to produce around 3,000 kg of vegetables during the cultivation season, which equals to 20-25 thousand servings of vegetables in the receiving kitchens. Students are also invited to practice in this market gardening initiative and during the last season (2021) two classes were invited at five occasions.

The Farmers Incubator (in Stadsbruk) is a programme for new small-scale green farming entrepreneurs in urban and peri-urban areas of Gothenburg with the aim to train and increase the number of ecological farmers committed to sustainable land management. The objective is to increase the number of local/ecological farmers in Swedish cities through “agripreneurship” training (agricultural entrepreneurship) and with a strong collaboration with the Gothenburg municipality which offers access to underutilised or abandoned public land. The incubator gathers, creates, tests and shares successful business models relevant to farmers providing knowledge and training on how businesses operate in this field. A winter training programme has been in place with capacity of around 10 new entrepreneurs every year. Run for the second consecutive year, the programme’s initial results demonstrate that the creation of a farming-oriented network, the opportunity to further training and thematic workshops have been beneficial to the farmers of the region. While new and existing farmers receive training on entrepreneurial and agriculture, the city of Gothenburg has the opportunity to collect feedback and evaluate its land matchmaking process. Overall, the Farmers Incubator has been a successful outcome of the SATURN project and the city is intending to continue even after the duration of the European programme. It is believed that the scheme will support the boost in the number of farmers and help regenerate the underutilized land of the city, resulting in a positive environmental impact in the area, such as the local food production, reduced transport and packaging emissions.

The LAB190 is strongly related with the recovering of underutilized farmland and enhancing generational change. Creating a model for match-making new green entrepreneurs with underutilised farmland in the urban hinterland has been one of the highlights of the Urban Farming Model of Gothenburg. This initiative has got the interest of various other European cities and regions, but it has also acted as a great way to regenerate and relive the abandoned spaces of the city. The objective is to develop a method for mapping available land and its future potentials. The mapping exercise aims to become a valuable interface for municipalities and private landowners, to make land available to new entrepreneurs within the green sector. Being a collaborative initiative between four municipalities (Gothenburg, Lerum, Alingsås and Essunga), LAB190 has great potential for scaling up across other cities in Sweden as well as European countries. Several capacity building and dissemination activities (webinars, food-led events)



supported by the city of Gothenburg have allowed for exchange of knowledge and the creation of a common land use vision between the cities involved.

The “Angered and Skogome” pilot case aims to recover peri-urban plots by supporting people in establishing innovative business models. The objective has been to facilitate small scale commercial vegetable production in the peri urban areas while establishing a broader urban farming scheme through the Model Farm, the Incubator and LAB190. The selected test sites of Angered and Skogome were chosen to increase urban food production and boost green entrepreneurship in and around the city centre of Gothenburg. Several activities, such as farmers roundtables, stakeholder assessment meetings and the production of a guide on testbeds, have been generated after the initial launch of the scheme demonstrating the positive outcomes of this pilot across the city. The initiative has now been expanded into creating a “test farm” to act as a community farm that will engage with multiple stakeholders in the area. The project has welcomed 6 new urban farmers to the testbeds in Angered and Skogome and with this, a total of 34 farmers are established on both testbeds, many of which have already registered their companies and began delivering to local customers. The majority of sales are still done through the so-called “REKO-rings” which is a popular system in the region, currently involving close to 300,000 customers across the Nordic countries. REKO-rings provide a way for producers of locally grown produce and customers to develop a relationship as well as providing a practical sales channel for growers. Operating through closed Facebook groups, customers order in advance and gather pre-packed bags at convenient locations, typically once a week. There has also been a slight growth in direct sales from the farms. Some farmers also deliver to restaurants in the Gothenburg area.

Through four different actions the Gothenburg model demonstrates that a successful urban farming scheme in dense areas is feasible, resulting in several benefits for the municipality, the farmers and the public. The green space will regenerate the area and provide a healthier and greener city, while the local food production and consumption will mitigate the carbon emissions in the area produced by transport and shipping.

#### *Networking for a Community-Based Recovery of Land and Practices - The Case of Trentino*

The territorial and socio-economic conditions of the Trentino province located in the middle of the Italian Alps contribute to make it a pretty peculiar case. There is a strong industrialized farming sector focused mostly on growing apples and vineyards yet based on a large number of small landowners who are part of the network of territorial cooperatives. This particular situation is not exempt from challenges or negative sides which is at the base of the decision of local administration and stakeholders to develop both a tool named “banca della terra - earth bank” and the Nutrire Trento network. The two tools have fairly different backgrounds, with the earth bank being an institutional tool developed by the local government (in accordance with national regulations), while Nutrire Trento and its follow-up, CSA “Naturalmente in Trentino”, is generated by a bottom-up process

coordinated by researchers of the University of Trento. The purpose of the Bank of the Earth is to link the processes of abandonment and non-cultivation with facilitating the access to plots of land by young or new farmers and agricultural businesses. Therefore, it acts as a meeting point between supply and demand and can become a precious tool for the protection of landscape, drawing attention to areas which are often neglected and at the same time offer the possibility to young people who intend to dedicate to agriculture, even if they do not come from farming families or do not have their own land, to find available plots. This could allow a generational change, or the consolidation of existing agricultural enterprises. At national level, the Italian law 154/2016 introduced the “*Banca nazionale delle terre agricole*” which has then been translated at a regional level the following year with the Trentino law 15/2017. This law is part of a wider reform of the law for the government of the territory. It is essentially an inventory of public and private uncultivated land, which the owners can temporarily make available to those who request it to put them back into production. In the case of public-owned plots the land is added to the earth bank directly by the municipalities, while in the case of privately-owned plots the public authority acts only as a link between the owner and potential new farmers that are asking for land availability. This demand has grown steadily in recent years not only as a reaction to the increased lack of jobs for young people but also as an answer to the need of reducing the detachment from nature and food chains.

Considering the relevance of the agricultural sector in Trentino, but also the related socio-environmental issues, a new demand has emerged for social inclusion in the agricultural sector, the promotion of formative programmes and the recovery of agro-ecological agricultural practices. Therefore, these aspects should be considered as crucial as the re-utilisation of uncultivated land. Recognising a serious economic, social and environmental gap between urban and rural landscapes, local institutions have undertaken the challenge to set up corrective projects, as in the case of Nutrire Trento. The Nutrire Trento initiative aims to promote more conscious consumption, raise awareness of more sustainable production and reconnect producers and consumers (Forno et al. 2020). As it is a participatory process, the main tool of the project is a round table that brings together local stakeholders to discuss issues related to the food system, its paradoxes and failures to plan shared solutions. Since 2017, the initiative has seen the participation of more than 125 actors active in the Trento and surrounding municipalities: agricultural producers, consumers, activists, researchers, shopkeepers, representatives of the institutions and categories involved.

The local context presents a very rich humus of initiatives consistent with its objectives. However, there is an evident lack of coordination between these players, resulting in dispersed and inefficient exploitation of the efforts and human resources involved and a suboptimal impact on the target audience.

For this reason, the main function of Nutrire Trento is to enhance the resonance of these realities, by optimising the interaction between the actors and developing new links, networks and opportunities. These functions are pursued in different ways: through networking at meetings, dissemination events, but also - and especially - through publicization using communication media. The main one

is the digital platform that allows the public to visualise the actors and locations of the Trentino short supply chain.

The COVID-19 pandemic has revealed the need to enrich Nutrire Trento's repertoire of actions by promoting its projects. The changes in consumption habits that occurred during the 2020 spring lockdown have led to the development of many spontaneous innovations that have also spread to the Trentino context. Precisely to monitor and investigate these new ways of buying, selling and consuming, the Nutrire Trento Round Table proposed an experiment that was called Nutrire Trento #Fase2. The goal was to provide support to local farms to sell directly to interested families and enhance the community's interest to buy local agricultural products and have them delivered at home. Besides taking part in weekly orders, participation in the project also involved the completion of three questionnaires, for both families and producers, to study the changes in purchasing patterns that had become a necessity during the lockdown and to investigate the sustainability over time of the proposed production, distribution and purchasing system.

For nine weeks, 68 families and 13 producers took part in the initiative, giving some interesting indications: first of all, a decrease in food waste, linked to better consumption planning. Secondly, a decrease in purchases from supermarkets and discount outlets, balanced by an increase in purchases in small shops, on producers' farms and home delivery. Finally, an increase in the consumption of local and national products and a decrease in the purchase of pre-cooked, pre-packaged and frozen food. The results obtained are very promising and represent an important step to support future enhancements of the initiative in order to involve larger numbers of producers and families. However, the project also encountered several problems and saw a steady decline in the number of users of the service. The questionnaires revealed that this was linked to the shortage of some products and the presence of a minimum order which made purchasing less convenient. To overcome these issues, the producers emphasised the need to plan seasonal production together with consumers.

One of the most important results of the Nutrire Trento #Fase2 project was the creation of a Community Supported Agriculture (CSA), thanks to the synergies among farmers that emerged. The CSA is a model of food production and distribution based on an alliance between consumers and farmers. Indeed, it is a more sophisticated alternative to food networks in Italy (e.g., Solidarity Purchasing Groups) since consumers are asked to commit to and support a group of farmers, both morally and financially. Farmers and consumers agree on the cultivation methods and the production plan by co-designing the whole process. Thus, consumers become partners by sharing the entrepreneurial risk and accepting the possibility of losing agricultural production. At the moment, 13 producers and 32 consumer families are involved in this initiative, but it is constantly expanding. An association has been founded to bring the two sides of the supply chain closer and create a real community bonding. This association acts as a legal entity for the CSA and it is responsible for the organisation of guided events at the producers' farms and other activities aimed at spreading the principles of the CSA, including

educational workshops for children and a dissemination blog with contributions from all members and partners.

### *Growing in the Community - The Case of Birmingham*

The Birmingham model is about developing a growing network in an urban environment that includes, growing, gardens and urban farming. Even though the two previous models have a focus on agriculture and entrepreneurship, the “Growing in the Community” scheme aims to spread awareness and engage with the community through farming. The team behind this model states that creation of physical space nurtures and presents opportunities for the generation of social space in the urban fabric.

Being at the heart of the second biggest city in England, entrepreneurial farming activities are not that easy, however the aim of this model is much more than just food production. The Urban Farming and Growing Network, a case study of the SATURN project, has identified itself as a group providing support to the community by “growing people”, using this activity as a mental health support as well as a community bonding. Birmingham’s scheme is not just about mitigating carbon in urban farming but enhancing its social benefits. One might wonder why such a scheme is relevant to the scope of this paper and the broader SATURN study, but it is important to mention that cities need a behavioural and systemic change in order to mitigate or adapt to climate change. Following the COVID-19 pandemic, there is an increase in community growing groups and engagement to open spaces (Mead et al. 2021), resulting in further exploration of green and community accessible spaces in cities. The “growing in the community” model is therefore, about mental health as much as food production and even though it does not operate as an entrepreneurial incubator at the moment, is seeking the city’s support to expand and explore business opportunities as well as the access to community gardens within close proximity from dwellings.

The Birmingham model operates in several community gardens, farms and allotments across the city addressing the various environmental benefits, the impact these have in urban communities as well as how these can be enhanced through a strong and enjoyable urban farming scheme. Due to their flexible structure, community gardens are considered less strict compared to allotments or farming plots, that require planning permissions and protections (Hardman and Larkham 2014) and therefore they are increasingly used in cities as ways to promote environment, a healthy lifestyle and social cohesion. Especially in a post-COVID-19 world, local food growing can provide both resilience and capacity (Mikadze 2020) in cities and peri-urban areas, demonstrating a different dimension of urban growing in relation to climate resilience.

The work undertaken by the Urban Farming and Growing Network, with the support of the SATURN project, has revealed many hidden beneficiaries and needs in the area of the West Midlands as well as positive outcomes of the community engagement in food growing activities. Similar to what Mousa et al. (2020) explain, the Birmingham model has also identified that the social aspect of a project is very significant during its initial stages, but it also helps in the creation

of a scheme that people feel they belong to and can be part of. Dealing with the community element together with the environmental challenges, this model revealed routes of collaboration and found ways to engage with local stakeholders they were not able to engage before. A landscape evaluation, a recognition of barriers and challenges in the area have enhanced the motion, and provided evidence demonstrating that a society-driven growing scheme is of real value to dense and urban environments.

The community focused, Birmingham model, comes as a complementary scheme to the more entrepreneurial models of Gothenburg and Trento. Using the dense urban environments of the city of Birmingham and its surroundings, it demonstrates how urban farming and growing can become an activity of contemplation, understanding and valuing of the land, and bring social cohesion to support the climate related acts in the area. It is important to mention that business and entrepreneurial activities are being explored, but the focus is on the way in which growing in cities can mitigate carbon emissions and support a healthier lifestyle while it provides for its citizens.

## **Discussion**

The collaboration between the different European cities and the expertise provided by SATURN have resulted in interesting findings and best practices in relation to urban farming and environmental challenges. The three models presented here are still developing, however they have been tested locally and demonstrated that the idea of growing and farming is possible in urban and peri-urban environments when a broader framework or system is in place to support it. Exploring agriculture-oriented models (e.g., Gothenburg) the study shows that urban farming is able to partly replace the food production in cities and regions, when a business model is supporting the broader idea and an awareness plan is in place. Having created a model for match-making new “green” entrepreneurs with underutilized farmland in the urban hinterland, Gothenburg city has created a market for smaller more sustainable farms, providing a more environmentally friendly way of farming, while it also supports local production and job creation. Both Gothenburg and Trento are looking into mapping and identifying available urban land, aiming at creating a network of land owners, farmers and local authorities who would all support the progression of small scale commercial crop production in cities and peri-urban areas. Especially for Trento, the goal is to support the creation of an established process to enhance interaction between farmers and citizens. The opportunity of farmers to join alternative food networks employing more sustainable methods will provide a more environmentally friendly urban farming structure while retaining economic benefits.

Whilst embracing the other two models, Birmingham, recognizing its growing population and the need for a healthier city, is creating an innovative model aiming to support mental health, community bonding and provide for a healthier lifestyle through growing food in open spaces and community gardens. The Birmingham model almost works in a therapeutic way, highlighting the significance of nature,

food and the benefits of local production in relation to mitigating and adapting to climate change. Using the experience of the established “Social farms and gardens” network as well as other passionate individuals, this model operates with local authorities and other institutions to find ways to establish “urban growing” in the city. One of the key findings is that using the SATURN tools, all models have found ways to engage with local stakeholders and explore further opportunities related to their region. The opportunity to learn about similar models across Europe, understand how these operate and extract best practices has also been greatly beneficial, for all schemes as some needed support in the business development and others needed to enhance their broader scope and introduce sustainable development goals in their framework. Citizen’s approach is encouraging to such pioneering models, since they agree that food should be produced in a manner that respects local tradition and “know-how” (87%), and comes from a geographical area that they know (81%) (European Commission 2020b). The short supply chain minimizes transport emissions and usually follows more sustainable patterns in food production and distribution. Overall, urban farming models offer adaptation solutions with regards to climate change either by supporting more sustainable food chains or by spreading awareness in relation to the environmental challenges. The models dealing with social and community cohesion have a major impact on the way in which communities understand climate crisis and how cities can integrate such initiatives.

## **Conclusions**

Food security is one of the most significant challenges we face and it is considered to become worse in the near future. Agriculture and farming play a very important role in food production, however the multiple climate and global challenges are creating several issues in the sector. While we are trying to feed a growing population, we should also aim for more sustainable and environmentally-oriented farming to be able to truly provide a resilient future. This paper identifies ways in which urban farming can support food production either by creating innovative green models or by adapting to climate challenges with the support of the whole community.

The three models presented above have provided initial findings on methods, policies and training required for farming to be successful in cities and peri-urban areas, however the broader SATURN project seeks to test such initiatives in more cities and countries across the globe, aiming to result to a coherent framework that will allow the creation of viable farming models on a smaller scale. The breakthrough in this study comes when one realises that urban farming and growing does not need to compete with large agricultural land or intensive agriculture, but to find its niche and unique market within the city/region of each area. With the support of Gothenburg, Trento and Birmingham cities, the SATURN project has identified methodologies where growing food in dense environments can be beneficial for the region; regeneration of the land, increase local produce, provide sustainable locally-grown food and minimize the CO<sub>2</sub>

emissions generated by transport. It is also a great way to engage with the wider community and spread awareness on the environmental benefits of a healthier city.

The exchange of knowledge between the three models has attracted further interest from cities in Slovenia, Greece, Spain, Italy, Sweden, Norway and New Zealand looking to test and engage further with the tools developed by SATURN. It is significant to state that while SATURN's goal is to provide the broader framework and the training for the cities to develop similar models, each area has its own policies and geomorphology and therefore the models will need to be adapted to each specific location and farming needs. This new concept of urban farming breaks from its traditional definition, aiming to support adaptation and mitigation activities that have been established in each region, while at the same time it supports the businesses, economy and mental health of the community.

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### References

- Bocchi S (2020) Agroecology: relocalizing agriculture accordingly to places. In *Bioregional Planning and Design*, volume II, 81–99. Springer.
- Consortium S (2019) *SATURN conference, workshop, exhibition*. K Moore, A Nikologianni. Birmingham, UK: Birmingham City University.
- European Commission (2020a) *A farm to fork strategy for a fair, healthy and environmentally-friendly food system*. Brussels: European Commission.
- European Commission (2020b) *The Eurobarometer survey*. Retrieved from: [https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance/eurobarometer\\_en](https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance/eurobarometer_en). [Accessed 6 August 2021]
- Forno F, Maurano S, Vittori F (2020) Costruire processi partecipativi attorno al cibo: Le esperienze di Bergamo e Trento. (Building participatory processes around food: The experiences of Bergamo and Trento). In E Dansero, D Marino, G Mazzocchi, Y Nicolarea (eds.), *Lo Spazio delle Politiche Locali del Cibo: Temi, Esperienze e Prospettive*.
- Grimm NB, Foster D, Groffman P, Grove JM, Hopkinson CS, Nadelhoffer KJ, et al. (2008) The changing landscape: ecosystem responses to urbanization and pollution across climatic and societal gradients. *Frontiers in Ecology and the Environment* 6(5): 264–272.
- Hardman M, Larkham PJ (2014) *Informal urban agriculture*. Springer.
- IPCC (2018) *Global warming of 1.5°C*. An IPCC Special Report Edited by V Masson-Delmotte, P Zhai, H-O Pörtner, D Roberts, J Skea, PR Shukla, et al. UN.

- Januszkiewicz K, Jarmusz M (2017) Envisioning urban farming for food security during the climate change era. Vertical farm within highly urbanized areas. In *IOP Conference Series: Materials Science and Engineering* 245(5): 052094.
- Jennings MD, Harris GM (2017) Climate change and ecosystem composition across large landscapes. *Landscape Ecology* 32(1): 195–207.
- Li L, Li X, Chong C, Wang C-H, Wang X (2020) A decision support framework for the design and operation of sustainable urban farming systems. *Journal of Cleaner Production* 268(Sep): 121928.
- Mead BR, Davies JA, Falagán N, Kourmpetli S, Liu L, Hardman CA (2021) Urban agriculture in times of crisis: the role of home food growing in perceived food insecurity and well-being during the early COVID-19 lockdown. *Emerald Open Research* 3(May): 7.
- Mikadze V (2020) Landscape urbanism and informal space-making: insights from a guerrilla gardening case in Montreal, Canada. *Journal of Urban Design* 25(6): 794–811.
- Mousa H, Elhadidi M, Abdelhafez H, Tonini P, Fellin L, Frongia A, et al. (2020) The role of urban farming in revitalizing cities for climate change adaptation and attaining sustainable development: case of the city of Conegliano, Italy. In A Sayigh (ed.), *Green Buildings and Renewable Energy: Med Green Forum 2019 - Part of World Renewable Energy Congress and Network*, 545–577. Cham: Springer International Publishing.
- Nikologianni A, Betta A, Pianegonda A, Favargiotti S, Moore K, Grayson N, et al. (2020) New integrated approaches to climate emergency landscape strategies: the case of pan-European SATURN project. *Sustainability* 12(20): 8419.
- Opdam P, Luque S, Jones KB (2009) Changing landscapes to accommodate for climate change impacts: a call for landscape ecology. *Landscape Ecology* 24(6): 715–721.
- Pradhan P, Kriewald S, Costa L, Rybski D, Benton TG, Fischer G, et al. (2020) Urban food systems: how regionalization can contribute to climate change mitigation. *Environmental Science & Technology* 54(17): 10551–10560.
- Soulard C-T, Valette E, Perrin C, Abrantes PC, Anthopoulou T, Benjaballah O, et al. (2018) Peri-urban agro-ecosystems in the Mediterranean: diversity, dynamics, and drivers. *Regional Environmental Change* 18(3): 651–662.
- Steinfeld H, Gerber P, Wassenaar TD, Castel V, Rosales M, de Haan C (2006) *Livestock's long shadow: environmental issues and options*. Food & Agriculture Org.
- United Nations Department of Economic and Social Affairs – UN DESA (2018) *68% of the world population projected to live in urban areas by 2050*. New York: UN DESA.
- von Wirth T, Fuenfschilling L, Frantzeskaki N, Coenen L (2019) Impacts of urban living labs on sustainability transitions: mechanisms and strategies for systemic change through experimentation. *European Planning Studies* 27(2): 229–257.